Development of Raman Analytical Technique for Biological Sample

Abstract

The overall aim of this study is to develop a new technology to study seaweeds for the improvement of aquaculture productivity. Indonesia is one of the top producers of seaweed in the world. The red macrophytic alga, *Kappaphycus alvarezii* is the main source seaweed for the industrial production of *kappa* type carrageenan. The quality of seaweed harvests has become paramount to obtaining good quality of carrageenan. A good quality of seaweed *K. alvarezii* containing about 40-50% of carrageenan. However, instability of environmental conditions may make it difficult to produce good quality carrageenan. Furthermore, harvests are often limited by seaweed diseases, one of the major problems in seaweed farming. *Ice–ice* is the most famous seaweed disease caused by bacterial pathogens. *Ice–ice* disease causes whitening of algae thallus and leads to fragmentation and eventually loss of biomass. Bacterial infection in the algal body often involves degradation of algal storage compounds by bacterial enzymes. To monitor and investigate the bacterial infection in seaweed body, low cost and effective analytical tools are needed. In this study, we demonstrated the ability of combining Raman spectroscopy with chemometric analysis to investigate infective enzymatic activities in seaweed body. A low cost Partial Least Square Regression (PLSR) model with reduced number of test samples was successfully achieved for quantifying the enzymatic reaction mixture with substrate and product in the alfa-amylases activity. In order to qualify of seaweed harvest, imaging Raman spectroscopy (iRs) was successfully used to observe carrageenan content in three different hierarchies of seaweed branches. Furthermore, low cost PLSR model and iRs were successfully used to investigate the carrageenan degradation activities of infected *K. alvarezii* by measuring the decrease in carrageenan content, as a substrate in bacterial enzymatic reaction. From this study, it can be concluded that iRs combined with chemometric analysis is a powerful tool to monitor conditions of seaweed quality.

Keywords

Raman Spectroscopy, Chemometrics, *Kappaphycus alvarezii*, Carrageenan